**Center Innovation Fund: JSC CIF**

# Coupled Human-Space Suit Mobility Studies

Completed Technology Project (2012 - 2012)

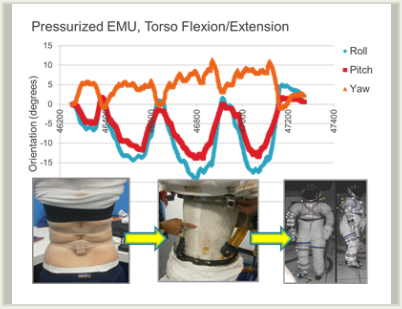
## Project Introduction

Current EVA mobility studies only allow for comparisons of how the suit moves when actuated by a human and how the human moves when unsuited. There are now new wireless inertial measurement units (IMUs) that are small enough to be worn in pockets of the space suit undergarments to provide real-time data on the postures and joint angles assumed by the suited test subject as they conduct simulated EVA tasks. The proposed development is to use the new IMUs with the data collection system that can synch across 32 human worn sensors and simultaneously link to the Vicon MX data collected from externally mounted suit reflectors. This will provide the first time-linked data sets for internal and external movements during suited mobility assessments. By understanding human-suit interaction, we can identify space suit design parameters to optimize EVA performance and reduce injury risk associated with fit and posture issues that can be implemented in EMU upgrades and future exploration suits.

The space suit is arguably the most intimate piece of space flight hardware yet we know surprisingly little about the interactions between the astronaut and this machine. Current EVA mobility studies only allow for comparisons of how the suit moves when actuated by a human and how the human moves when unsuited. Over decades, engineering and science teams have attempted to bridge this gap using tools from live x-rays to shape tape to pressure sensors but none of these technologies have proved to be both safe and reliable. However, there are now new wireless inertial measurement units (IMUs) that are small enough to be worn in pockets of the space suit undergarments to provide real-time data on the postures and joint angles assumed by the suited test subject as they conduct simulated EVA tasks. Thus the proposed development is to use the new IMUs with the data collection system that can synch across 32 human worn sensors and simultaneously link to the Vicon MX data collected from externally mounted suit reflectors. Initially, success of this project will be measured by the ability to transmit the wireless signals through the pressurized suit without significant loss of signal or distortion and the development of software code to accurately describe the motion of joint segments during simulated EVA tasks. Follow on efforts will provide the first time linked data sets for internal and external movements during suited mobility assessments.

## Anticipated Benefits

A better understanding of human-suit interaction will allow engineers to identify space suit design parameters to optimize EVA performance and reduce injury risk associated with fit and posture issues that can be implemented in EMU upgrades and/or future exploration suit designs.




Project Image Coupled Human-Space Suit Mobility Studies

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## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Johnson Space Center (JSC)

**Responsible Program:**

Center Innovation Fund: JSC CIF

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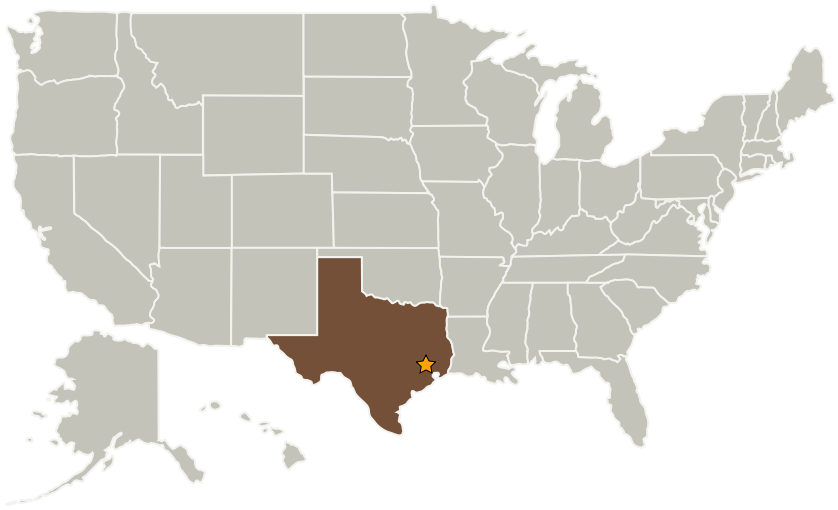
## Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| ★Johnson Space Center(JSC) | Lead Organization | NASA Center | Houston, Texas |

| Primary U.S. Work Locations |
|---|
| Texas |

## Project Management

**Program Director:**
Michael R Lapointe

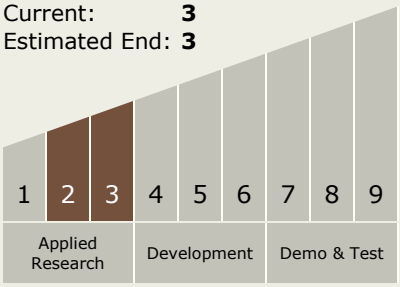
**Program Manager:**
Carlos H Westhelle

**Project Manager:**
Lindsay T Aitchison

**Principal Investigator:**
Lindsay T Aitchison

## Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**




## Technology Areas

**Primary:**

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.3 Human Health and Performance
    - TX06.3.2 Prevention and Countermeasures

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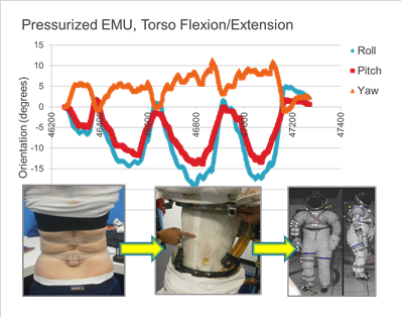
## Images

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Project Image Coupled Human-Space Suit Mobility Studies
*(https://techport.nasa.gov/image/2270)*